DOCUMENT RESUME

ED 122 597 FL 007 351

AUTHOR Blaubergs, Maija S.
TITLE Are Structural Features of Word Meaning Reflected in Judgements of Semantic Similarity and Difference?
PUB DATE [72]
NOTE 38p.; ; Some tables may reproduce poorly
AVAILABLE FROM Maija S. Blaubergs, Educational Psychology Dept., University of Georgia, Athens, Georgia 30602

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Cognitive Processes; *Deep Structure; Language Patterns; Language Research; Linguistic Theory; *Models; *Psycholinguistics; *Semantics; *Structural Analysis; Surface Structure; Syntax

ABSTRACT

The question of whether word meanings have internal structure identical in kind to the syntax of sentences is examined. Evidence is sought for the structural aspects of word meaning and the issue of whether judgements of similarity between words is based on meaning content or on meaning structure is raised. Four hypotheses were tested: (1) structural components are elements of the internal lexicon and are used by speakers in making judgements of similarity; (2) core meanings representing fields in the internal lexicon are used by subjects in making similarity judgements; (3) if two aspects of meaning covary in a subset of words, both aspects are used as a basis for similarity judgements; (4) meaning content is a more salient basis for similarity judgement than are structural components. Two word-comparison tasks were used to test the hypotheses, sorting and triad comparison. In the latter, subjects make judgements of similarity or difference about three words at a time. Results show that the meaning content appears more salient than meaning structure, and only in certain cases does the latter provide a basis for similarity judgements. Because of different strategies used by subjects, however, a direct relationship between similarity judgements and the content of the internal lexicon cannot be assumed. (CLK)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED122597

Are Structural Features of Word Meaning Reflected in Judgments of Semantic Similarity and Difference?*

BEST COPY AVAILABLE

Maija S. Blaubergs

University of Georgia

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

The semantic representations of many words in an internal or subjective lexicon very likely have a quasi-syntactic organization. Proponents of the linguistic theory of "generative semantics" (Newmeyer, 1970; Postal, 1970) have argued strongly that word meanings have an internal structure that is identical in kind to the syntax of sentences. Investigators of semantic memory have also often assumed a quasi-syntactic organization for many words (e.g. Kintsch, 1972; Rumelhart, Norman & Lindsay, 1972; Quillian, 1967; Winograd, 1972). Moreover, it is hard to see that word meanings could be completely structure-free, i.e. incoherent mixtures of content with no formal schemas of organization that specify how content features are related to each other. Psychological evidence for the reality of the structural aspects of word meaning is difficult to obtain, but two types of methodology currently exist. One uses reaction time (e.g. Collins and Quillian, 1970; Meyer, 1970) and is not considered further here. The other uses subjects' judgments of similarity and difference in meaning (e.g. Fillenbaum and Rapoport, 1971; Henley, 1969; Miller, 1969; Steinberg, 1967). Such studies have typically used sorting tasks, in which subjects group words together presumably on the basis of the shared features of the words, or make other judgments of similarity. Then, the organization of the lexicon according to shared or related content is inferred from the groupings made or from related measures of semantic distance. The present study considers this kind of psychological data, and seeks evidence for the structural aspects of word meaning by ask-

FL007351

ing whether such judgments tend to be based predominantly on meaning content or on meaning structure, and, if the former, whether there are characteristic conditions under which judgments are based on structural aspects of meaning. Previous work has assumed that subjects' judgments of similarity directly reflect the organization of their internal lexicons. However, it is possible, as will be argued in more detail later, that the task requirements elicit strategies from the subjects that intervene between the internal lexicon and the judgments made and that have the effect that the judgments reflect only certain aspects of the lexical entries and operate to conceal others.

Similarity judgments were predicted using a model of the structure of lexical entries that is similar to some existing conceptualizations (e.g., Fillmore, 1968; Gruber, 1967; Kintsch, 1972; Rumelhart, Norman, & Lindsay, 1972), though these models are not at all explicit about the aspects of meaning of concern here. The present model utilizes the concept of "field" and a notion similar to "case". A field is defined here as a group of words characterized by a common core meaning, e.g., 'building' in house, church, kennel, etc., 'wash' or 'clean' in shampoo, launder, scrub, etc., 'vehicle' in snowmobile, ambulance, bulldozer, etc. In addition to the core meanings, the model assumes that the meaning of a word can embody additional content that is in a case-like relationship to the core meaning. For example, flog and punch contain a core meaning 'hit', but also incorporate additional meanings, 'with a whip' and 'with a fist', respectively that are in an instrumental relation to the core meaning.

The case-like relations are here called "structural components of meaning"; the specific content they embody will be called the "realization" of the structural component. Thus, punch has an INSTRUMENTAL/MANNER structural component, realized with the content 'fist'. Similarly, stable has

a DATIVE structural component, with the realization 'for horses'. Other realizations of the DATIVE component in lexical items with the same core meaning as stable ('building' or 'enclosure') would be 'for dogs' as in kennel, 'for pigs' as in sty and 'for chickens' as in coop. The same realization can also occur in lexical items from different fields, e.g., stable, bridle, and fodder all have 'for horses' as their realization of the DATIVE component. The core meanings and the realizations are essentially categories of meaning content, while the structural components are aspects of meaning structure.

Theoretically, within each field, there is one core meaning and one or more realizations of each structural component. However, this study will be limited to examining only one structural component per lexical item in any comparison.

Some of the structural components are somewhat analogous to selection restrictions, i.e., specification of features of words that determine whether they may be used in particular roles in a sentence given that some other words are to be used in particular other roles in that sentence. These structural components can be subdivided into those which pertain to the subject of the core meaning, those which pertain to an object, and those which pertain to a dative. The specificity of the SUBJECT, OBJECT, or DATIVE that is a structural component of a word varies from total specificity (a single other lexical item) to a very loose specification (e.g., a feature common to many other lexical items). The deep structure of the meaning of words with these structural components might be represented as follows: 'to vocalize' (core meaning) + 'horse' (SUBJECT) = to neigh; 'to wash' (core meaning) + 'hair' or 'rug' (OBJECT) =

to shampoo; and, 'building' (core meaning) + 'for dogs' (DATIVE) = kennel. See Table 1 for further examples from various fields.

- - - - - - - - - - - - - - - -
Insert Table 1 about here
- - - - - - - - - - - - - - - -

Some of the structural components are more analogous to adverbial structures in sentences, i.e., the PURPOSE, LOCATIVE, and INSTRUMENTAL/MANNER structural components. The PURPOSE structural component adds a specification of purpose or function to a core meaning. The analogues in sentences are some adverbial phrases or clauses, possibly introduced by because, in order to, so that, due to, or for, that express the purpose or reason for elements or events in a sentence. A deep structure of a word meaning involving the PURPOSE structural component may be represented as follows: 'traveller' (core meaning) + 'religious goal' (PURPOSE) = pilgrim. PURPOSE is probably a more complex component with a further internal structure of its own. For example, a frequently encountered purpose or function is 'for protection.' However, it is expandable in expressing the meaning of the same word to 'for protection against something,' e.g., where the something is variously specified as 'rain' or 'sun' in umbrella and parasol respectively. For the purposes of this study, all the knowledge of the real world that is involved in the PURPOSE of a core meaning will not be examined, but the PURPOSE structural component shall be considered to have various potential degrees of complexity in its deep structure, and that complexity of deep structure sufficient to contrast a word with others in a set will be used or assumed.

The LOCATIVE structural component specifies a location that combines with a core meaning. A deep structure with a LOCATIVE structural component may be represented as follows: 'vehicle' (core meaning) + 'on snow' (LOCA-

TIVE) = snowmobile. This structural component is comparable to a place adverbial designating 'where?' or 'to where?'.

A possible extension of the LOCATIVE structural component is a SOURCE structural component exemplified by the following deep structure representations: 'meat' (core meaning)+ 'from pigs' (SOURCE) = pork; 'material' (core meaning) + 'from sheep' (SOURCE) = wool.

The INSTRUMENTAL/MANNER structural component specifies either the instrument for a core meaning or a way or manner that combines with a core meaning. Although INSTRUMENT and MANNER categories may be treated separately, there are numerous borderline instances which would be excluded from the analysis unless the two were combined, as has been done, into a single dimension ranging from pure instrument examples to pure manner examples. A semantic representation would be the following: 'to hit' (core meaning) + 'with a whip' (INSTRUMENTAL/MANNER) = to flog.

Although the particular model presented here may turn out ultimately to be wrong in many details, something analogous to structural component must be present in lexical entries. For instance, the meaning of punch requires more than purely an associative relation between the contents 'hit' and 'fist': there must be some structure that marks the latter as being in an instrumental relation to the former. A parallel argument can be made for all the lexical entries discussed so far. Many of the predictions of similarity judgments made in the experiments to follow would probably be made by any model that incorporated a notion like structural component.

The present experiments provide direct comparisons between judgments based on content alone and judgments involving structural component.

The hypotheses tested comprise the following:

1) Structural components are elements of the internal lexicon

and as such are used by subjects in making judgments of similarity.

2) Core meanings representing fields of the internal lexicon are used by subjects in making similarity judgments.

3) If two aspects of meaning covary in a subset of words, both aspects are used as a basis for similarity judgments.

4) Meaning content is a more salient basis for similarity judgment than structural components.

Two types of tasks were used: sorting tasks and triad comparison tasks. In the latter, subjects are asked to make judgments of similarity and difference about three words at a time. In each task, some of the meaning components were varied and some held constant, in order to discover which aspects of meaning are utilized as the basis for similarity judgments.

A major difficulty in the design of the tasks concerned selecting representative words to be used as stimuli. Ideally, one would have lists of words available with the required semantic properties, and then select words randomly from the appropriate lists. Unfortunately, no such lists exist. Some lists of words were constructed for various fields and for various structural components. Stimulus words were selected so as to avoid ambiguous words, or words which pilot work had indicated were unknown to college students. The stimulus selection is, unfortunately but inevitably, open in principle to the possibility of stimulus-sampling bias due to an experimenter's intuition as to what subjects of the same language and cultural background are likely to choose as similar. Given the lack of standard materials to sample randomly from, there is no systematic way of eliminating all possibility of such bias. However, since the main motivation and novelty of the study concerned the structural-component aspects of meaning, one would expect any bias to favor selection of stimuli that would yield evi-

dence for structural component as a basis of similarity judgments. The results are examined in light of this possibility when this issue is returned to in the Discussion.

The Sorting Experiment

The hypotheses were tested in the following way: sets of words were constructed so that some words shared structural components and some shared core meaning, and for each set of words specific groupings were predicted on the basis of these postulated aspects of the internal lexicon. If sorting is done by field, the subjects would group together all the words with a common core meaning, e.g., in one set, the words from the fields of 'kill' and 'wash' would each constitute a grouping. If sorting is done on the basis of the structural component, the words grouped together would be from both fields, e.g., one pile of the words with an OBJECT component, to shampoo, to launder, to assassinate, to butcher; another pile of the words with an INSTRUMENTAL/MANNER component, to sponge, to mop, to behead, to electrocute. If subjects sort according to structural component with no similarities in content present, strong evidence for the structural components would be provided. If sorting is done using both field and structural component concurrently, the groupings made by the subjects would consist of words from the same field and with the same structural component in all cases, e.g., to shampoo, to launder; to mop, to sponge; to assassinate, to butcher; to behead, to electrocute. The solution based on field should occur earlier in the set of three solutions given by each subject than the solution based on structural component if content is a more salient aspect of meaning.

Method. Sixty subjects participated in the experiment as part of an introductory psychology course requirement.

The words used in the sorting task were printed in capital letters on small cards. Three sets of words were used with 8 to 12 words per set. The stimulus words used were fodder, birdseed (DATIVE), laxative, stimulant (PURPOSE) with a core meaning of 'ingestible', kennel, coop (DATIVE), store, church (PURPOSE) with a core meaning of 'building' and dress, trousers (DATIVE), mittens, raincoat (PURPOSE) with a core meaning of 'clothing', in Set 1 and riverboat, dunebuggy (LOCATIVE), ambulance, bulldozer (PURPOSE) with a core meaning of 'vehicle', chalet, igloo (LOCATIVE), restaurant, church (PURPOSE) with a core meaning of 'building' in Set 2. The stimulus words for Set 3 were given in the example in the introduction to this experiment. Up to 3 subjects were run simultaneously. Each subject sorted 2 of 3 sets, three times each for a total of 120 solutions for each of the sets of words. These sets of words were intermingled with others, not reported on here, in which only the content categories were compared and the order of presentation of the sets of words was randomized across subjects.

Subjects recorded their solutions on answer sheets and wrote down in the space provided what aspect of meaning they used in making each grouping.

A measure of the saliency of the judgments can be determined from the order in which the subject give their various solutions: the most salient aspects of word meaning would presumably be utilized in the first solution given, etc.

Results. Solutions were classified as identical if the number of groupings and the individual words within each grouping were the same, but neither the order of the groupings on the answer sheet not the order of the words within each grouping was a criterion for identity. Common

solutions are solutions given by more than one subject. Individual solutions are solutions given by only one subject.

Sorting occurred by field for 7%, 27% and 30% of the solutions in the three sets of sorts used, as shown in Figure 1. Among the solutions not based on field, sorting could take place on the basis of identity of structural component (across fields and realizations) or on the basis of the structural component and field simultaneously. No solutions occurred that were based on structural component alone. However, for two of the sets of

- - - - - - - - - - - - - - - - -
Insert Figure 1 about here
- - - - - - - - - - - - - - - - -

sorts, Set 2 and Set 3, 8% and 15% respectively of the solutions were based on the combined identity of structural component and field.

A saliency measure was calculated as follows: solutions given first, second, and third were given scores of 3, 2, and 1 respectively, while if the solution under consideration was not given at all by a particular subject it received a score of 0 for that subject.

The mean saliency measure of the field solutions was 1.65, indicating field to be a very salient dimension for sorting, since this was significantly greater at $p < .001$ (as determined by a sign test), than the saliency measure (0.37) for the solutions based on field and structural component. Thus, sorting by field occurred more frequently and earlier in an subject's three solutions than sorting by field and structural component simultaneously.

In Set 1, only 7% of the solutions were of the predicted types, all based on field, and there were a very large number of individual solutions (32 out of a total of 41 types of solutions). In examining the unpredicted common solutions and the reasons given for them, two problems are evident

that no doubt contributed to the lack of predicted results obtained with this sort. One is the tendency to subdivide one or more of the fields into smaller fields (rather than to subdivide the fields according to structural component). An example of this tendency is found in the four piles made by a number of subjects: 'clothing', 'buildings', 'medicine', and 'food items'. Clearly, the field of 'ingestibles' is being subdivided into 'medicine' and 'food'. These groupings may themselves be classified as fields since, if 'ingestibles' were an accepted core meaning, the whole field should appear as a grouping both frequently and saliently. The other tendency is to group fodder separately, either on the basis of not knowing its meaning or misconstruing it as "excrement".

The common solutions for Set 2 and Set 3 that do not fall within the predicted types of solutions also constituted approximations to sorting on the predicted aspects of meaning, i.e., some of the expected groupings may be subdivided or combined, or single unknown words may be isolated, etc. For example, a number of subjects gave solutions in which riverboat was used in an unexpected way, grouping it with chalet and igloo, as "all places where one might live", thus, possibly confusing riverboat with houseboat. A typical example of variations in grouping occurred when five subjects kept the 'vehicle' field as one grouping and divided the 'building' field into church, restaurant, ("public buildings"), and chalet, igloo ("home--place to live" or "shelters in snow"), indicating some reference to PURPOSE and LOCATIVE distinctions, but again indicating also the tendency to group realizations by superordinate category.

Conclusions. Sorting by field (a content category) was predominant: the most frequently given solutions in all sets of sorts were those predic-

ted on the basis of field; the solutions based on field were significantly more salient than the next most frequently given solutions; some of the unpredicted common solutions included one or more groupings consisting of all the words from a field; some groupings in the unpredicted solutions were subdivisions or combinations of field groupings. Further, no solutions were given on the basis of structural component alone. However, the second most frequently given solution-type was the one predicted on the basis of the simultaneous use of field and structural component, i.e., the words in each grouping were both from the same field and shared the same structural component.

In brief, sorting appears to be based primarily on content.

Two-Way Triads Experiment

In two-way triads, both the two most similar words and the two most different words are to be chosen by the subjects. Similarly to the sorting experiment, a set of triads was designed to investigate the relative saliencies of field and structural component and test several of the hypotheses. In each triad, two words were from the same field and two had the same structural component but were from differing fields. For example, in gunboat--rowboat--windmill, gunboat and rowboat share a core meaning ('boat'), and rowboat and windmill share an INSTRUMENTAL/MANNER structural component. The choice of gunboat and windmill as most different would indicate perception of both of these similarities (field and structural component). Like the sorts, these triads present similarities of content (field), and similarities of structure (structural component), and inquire whether both kinds of similarity are perceived, and which is more salient.

Method. Twenty introductory psychology students participated in the experiment as part of a course requirement. They had previously participated in the first of one-way triads experiments reported later.

The two-way triads comprised twenty-six triads representing the SUBJECT, OBJECT, DATIVE, PURPOSE, LOCATIVE, SOURCE, and INSTRUMENTAL/MANNER structural components. The triads are shown in Table 2. The triads were presented on

- - - - - - - - - - - - - - -
Insert Table 2 about here
- - - - - - - - - - - - - - -

dittoed sheets with each triad followed by a most similar and a most different column. Each column contained pairs of letters assigned to the words in each triad (A-first word; B-second word; C-third word). Subjects indicated their choices by circling the pairs of letters corresponding to the words chosen. The final column provided space for the written reasons for each choice. The triads were presented in 4 different orders on 3 pages whose order varied systematically. The triads were ordered randomly on each page, but this order was constant across subjects. The order of the words within a triad was again random except for equal representation of the six possible orderings.

Subjects were instructed to judge on the basis of the actual meanings of the words and not on the basis of any superficial characteristics of them, and to indicate any words with unknown meanings.

Results. Two potential bases of similarity judgments were present, same field (a similarity of content) and same structural component (a similarity of form). However, unlike the sorts, the triads do not allow a grouping in which both the field and the structural component are the same.

The results are presented in Table 2. In the chi-square calculations for the most similar judgments, all choices were considered quality likely. All distributions of the three most similar choices were significantly different from chance distributions at $p < .001$ except for the first LOCATIVE

triad for which the chi-square value was significant at $p < .01$. Same field was a far more salient basis of most similar choice than same structural component. In all triads, the most choices, in fact almost all the choices were made on the basis of field. Only 23 of the 520 most similar choices, averaging less than one choice per triad, were made for the same structural component, as compared with 15 choices of pairs of words presumed to have no salient meaning dimension in common. In all triads, sign tests indicated that significantly more field choices than structural-component choices were made. The levels of significance are indicated in Table 2.

In the chi-square calculations for the most different choices, the unpredicted choices were combined into one category thereby allowing one degree of freedom. In twelve triads, the most different comparisons gave insignificant chi-square values, indicating that the distribution of the predicted choices and the unpredicted choices did not differ from a chance distribution. Of the fourteen triads with a chi-square significant at at least $p < .05$, in thirteen the most frequently given responses corresponded to the predicted response as shown in Table 2. This indicates that in half of the triads, most subjects did not perceive both postulated dimensions of meaning; in particular, they did not perceive similarities due to a common structural component. Further, inspection of Table 2 shows that many subjects chose the pair of words sharing a structural component as most different. The explanation for these results may be gleaned from the reasons for the choices given by the subjects.

These reasons indicate a tendency of considerable theoretical interest which was found in the triads for all the structural components. The tendency was to use the differences in the two realizations of the structural

component to justify judging the corresponding words as most different rather than as similar. For example, "to do with horse vs. duck" is given as a reason for choosing to waddle and to sire as most different; "to bark--dog vs. to suckle--human" justifies the choice of bark and suckle as most different; the reasons why to shovel and to knead are most different include "uses hand vs. shovel" and "done with hands vs. tool specified"; "traveller on land vs. on water" is given as a reason for judging pedestrian and steamboat as most different; "common in desert vs. in the mountains" differentiates dunebuggy and mountaineer; and "lives on beach vs. in suburbs" differentiates beachcomber and suburbanite; while "warship used for war and apron for peace" is a reason given to justify choosing the items with a common structural component as most different. Sometimes the reasons stress the difference in the realizations of the structural component. For example, in SUBJECT triad, to cough --to meow--to trot, "to meow is vocal movement by cat, and to trot is a muscular movement by horse," and in LOCATIVE triad, vehicle--dunebuggy--mountaineer, "vehicle and beach vs. person and mountains," are amongst the reasons given. These reasons help to explain the unexpected choices of most different responses. They indicate that many subjects have perceived the common structural component (as expected), but instead of basing a most similar judgment on it, they use the difference in the realizations of the structural component to justify a difference judgment. This behavior is probably a consequence of a search strategy used by the subjects: perhaps in searching for a difference, subjects seek a difference that they can easily justify, and the difference in the realization of the structural components is one that is readily available from their lexical entries.

Conclusions. The saliency of field is again confirmed. Firstly, only in half of the triads was there a significant indication that the sameness of structural component was noted at all. Secondly, the difference in realizations was stressed in the reasons given for the most different choices. The lack of evidence that structural component in its abstract form, i.e., without identity of realization, contributes to the perceived similarity of meaning parallels the finding in the sorting task.

One-Way Triads Experiment: Same Field

One-way triads, in which only one judgment is required, that of "most similar" were used to test more directly whether structural components are used, as a basis for similarity judgments without other simultaneous comparisons. In this set of triads, unlike the previous sets, all three words were from the same field. The stimuli were selected so that two words included the same structural component as well as being from the same field. For example, in the triad, sailboat--rowboat--gunboat, sailboat and rowboat both contain an INSTRUMENTAL/MANNER component which is not present in gunboat; in to call-to neigh--to quack, to neigh and to quack both have SUBJECT components, whereas to call is not restricted to a special class of subjects, although it is from the same field. It is expected that subjects will choose the words sharing a common structural component as most similar in meaning. If the task tends to elicit solution strategies that may interfere with the direct reflection of the lexicon in the judgments made, the reasons given by the subjects are likely to reflect this.

Method. Thirty introductory psychology students participated in the experiment as part of a course requirement (twenty of these also participated in the two-way triads experiment afterwards).

The one-way triads are shown in Table 3. Twenty-four triads comprising five triads representing each of the LOCATIVE, INSTRUMENTAL/MANNER, and PURPOSE structural components and three triads representing each of the DATIVE, OBJECT, and SUBJECT structural components were used.

- - - - - - - - - - - - - - -
Insert Table 3 about here
- - - - - - - - - - - - - - -

In about half of the one-way triads, the third word in the triad was a general term for the field, e.g., to reproduce in the triad including to calve and to foal, and in the other triads, the third word had a different structural component, e.g., restaurant which has a PURPOSE structural component in the triad including kennel and stable, both with DATIVE structural components. Both kinds of third terms were included in order to have as wide a range of opposing words as possible. The general terms are marked by a G in Table 3.

The answer sheets and the procedure followed were the same as for the two-way triads except no judgments of most different were required, the triads were randomly ordered on two pages with subjects alternately receiving one or the other page first, and the order of the words themselves (two with the same structural component and one without) within each triad was randomly chosen except for equal representation of the three possible orderings.

Results. The number of subjects that chose the predicted pair as most similar was compared with the number of subjects making one of the other two choices. If all choices were of equal probability, one-third of the subjects would make the predicted choice. Chi-squares with one degree of freedom were calcu-

lated for each of the triads after collapsing the unpredicted choices into one category. Table 3 shows the number of subjects making each of the three possible choices and also shows the significance levels of the chi-squares for each triad. In all triads, except one, the most frequent choice was the predicted choice. The exceptional triad consisted of the words, to shampoo, to launder, and to rinse, with to shampoo and to launder postulated to contain specific realizations of the OBJECT structural component. Eleven of the thirty subjects did indeed classify those words as most similar. However, sixteen subjects classified to rinse and to shampoo as most similar giving such reasons as "both used on hair," "methods used when washing hair", "follow each other." In at least some of these reasons, it is apparent that the OBJECT structural component was perceived, i.e., reference was made to the realizations, 'hair' and/or 'clothes.' Thus, the problem stems from the interpretation of to rinse--it was given a realization of 'hair' by some subjects although it is not necessarily specific to hair. The reasons given for the choices indicate that the subjects approached many of the triads with a strategy of searching for a general term of which the other two terms could be viewed as subcategories: Thus, the two subordinate terms are classified as most similar. For example, "types of murder" was a common reason given for choosing infanticide and genocide as most similar in a triad also including murder, though a majority of subjects did mention the class of OBJECT involved as in the reason "specific groups murdered". In another triad in which to reproduce was the general term, "reproductionn of animals" was a common reason for choosing to calve and to foal as most similar, and in the triad, refrigerator-toaster-appliance, the typical reason for choosing refrigerator and toaster as most similar was "both appliances". For about half of the triads, this strategy is appropriate since one of the

terms is actually superordinate to the other two. However, the strategy enables the subjects to see the two subordinate terms as similar without necessarily perceiving the common structural component. But, sometimes the strategy was used inappropriately. In about half of these triads the third word was not a general term yet in some cases if was nevertheless used and resulted in one of the terms being misconstrued or at least construed in an unusual manner as a general term. For example, while 16 subjects chose the predicted words umbrella and shield as most similar, 14 subjects chose umbrella and robe, giving reasons such as "shields from the elements", "shields from rain vs. cold" and "types of shields." Clearly, these subjects were using the strategy of looking for a general term and shield was the only possible candidate.

In many of the triads, however, especially where there was no general term, the strategy described was rarely used, and the reasons given for the judgments did indicate that the common structural component was perceived. For example, "places for non-human animals" was given as a reason for choosing kennel and stable as most similar indicating that the shared DATIVE structural component was the basis for the choice. Other examples of reasons for most similar judgments include "treat and feed people" for the choice of hospital and restaurant, "top and bottom of house" for the choice of attic and cellar, "people of their type of terrain" for the choice of mountaineer and beachcomber, and "specific ways of wounding" for the choice of to stab and to shoot. In these reasons, and even more specifically in some others, e.g. "eats vegetables and fruit vs. eats meat" for herbivore and carnivore, the specific realizations of the structural components are given along with an indication of the structural component itself.

Conclusions. As predicted, given three words with the same core meaning, subjects chose as most similar the two words also sharing a structural component. In some cases, the reasons clearly suggest that subjects attempted to solve the triads task by looking for a general term to which the other two terms could be viewed as subordinate. When this strategy is used, appropriately (in the triads where a general term is present) or inappropriately, the presence of the structural components is not precluded, but it may be the case that instances of a general category in the internal lexicon provide the most easily available similarity for use in the judgments. It does appear, then, that the strategy used by the subjects controls the way in which they use their internal lexicons in making the judgments. Thus, the general one-way triads cannot be used as conclusive evidence for the perception of the structural component, but some of the reasons given where the strategy was apparently not operating, especially in those triads where there was no general term, do suggest that the common structural component was perceived and was used as the basis for the judgments.

One-Way Triads Experiment: Different Fields

So far, the evidence for the structural component being used as a basis for similarity judgments has been equivocal. In the one-way triads, in which all the words were from the same field, the reasons given for the choices shed doubt that common structural components were actually perceived in many word pairs chosen as similar: the reasons indicated that a strategy was used that permits the subjects to perceive the predicted words as similar without noting the sameness of the structural component. The results of the two-way triads show almost no judgments of meaning similarity being based on same structural component per se with both field and realization

differing in two words. Also, in the sorts no solutions were given based solely on structural component, but some solutions were based on core meaning and structural component simultaneously. In all cases, when structural component covaried with meaning content, the words in which this covariation occurred were treated as similar, but when structural component was the sole potential basis for similarity, the predicted similarity judgments either simply did not occur or intervening strategies appeared to operate. The question arises whether the structural component is considered independently of its realization, or whether only the content of the realization is recognized. This set of triads was designed to differentiate between the structural component and its realization.

In these triads, all three words are from different fields: two of the words share some aspect of the common realization, e.g., in one of the SUBJECT triads, all the words share a reference to 'infant,' but in two of the words (to teethe and to coo), 'infant' is a realization of the SUBJECT structural component and in the third word, to diaper, it is a realization of the OBJECT structural component; in one of the INSTRUMENTAL/MANNER triads, all of the words share a reference to 'knife' or some similar instrument, but two of the words (to stab and to slice) share the INSTRUMENTAL/-MANNER structural component, whereas in the third word, to sheathe, the action is done to rather than by the knife. If the two words sharing the same structural component are chosen most frequently as most similar, then the basis for the choice is very clearly the structural component itself rather than the concept involved in the realization, e.g., 'infant' or 'knife' since this concept also appears in the third term. These triads provide a control for the possibility that when two words with the same

realization of the same structural component are chosen as most similar, the structural component is not necessarily used as a criterion in the decision. As mentioned previously, and will be discussed further later, strategies focusing first on content may be biasing the judgments. These triads attempt to by-pass this problem by eliminating obvious content categories as a basis for choice. Thus, in these triads, only the structural component is predicted to provide the basis for similarity judgments.

Method. Twenty five introductory psychology students served as subjects.

Two triads representing each of the six major structural components under consideration constitute the stimuli as shown in Table 4.

- - - - - - - - - - - - - - -
Insert Table 4 about here
- - - - - - - - - - - - - - -

Two random orders of triads were used; alternate subjects received each order. Each half of the triads contained one triad for each of the six structural components. Otherwise, the procedure followed was identical to that used in the previously reported one-way triads.

Results. The number of subjects choosing each of the three pairs in a triad as most similar is shown in Table 4. In eleven of the twelve triads, more subjects made the predicted choice than the other two choices combined. Chi-squares with one degree of freedom were calculated for all triads with the two unpredicted choices collapsed into one category. All except two chi-square values were significant at $p < .001$. The two exceptions were the DATIVE triad, pacifier -- crib -- papoose, and the SUBJECT triad, to neigh -- to trot -- to mount. The unexpected results of the DATIVE triad reflect the fact that all seventeen subjects that chose crib and papoose as most similar misinterpreted the meaning of papoose. They took it to be the holder for an Indian baby rather than the baby itself, e.g., "both are things a

baby would be put into" or "both places a baby can be placed to sleep." Of the subjects making the predicted choice, crib and pacifier, the reasons typically included reference to a DATIVE structural component, e.g., "used by a baby." A genuine ambiguity in one of the words was the reason for the unexpected results in the SUBJECT triad, to neigh -- to trot -- to mount. It was predicted that to neigh and to trot would be chosen as most similar on the basis of 'horse' being the realization of the SUBJECT structural component in both, but twelve subjects chose to trot and to mount as most similar. Most of these subjects apparently interpreted to trot as involving 'rider' and thus as the realization of the SUBJECT structural component and 'horse' as the realization of the OBJECT structural component. Thus, for them, to trot and to mount involved the same realization of the OBJECT structural component. Typical reasons included "one mounts and then one trots," "both concerned with riding or horse." Reasons given for the predicted choice, made by thirteen subjects all referred to 'horse,' e.g., "horse does both" "both are actions of the horse, mount is of the rider" clearly indicating the presence of the SUBJECT structural component.

The other triads all confirmed the expected results: when subjects were presented three words from different fields, but all with some similar content, they selected the two words that included the same structural component in their meaning. The reasons given for the choices indicate the subjects' perception of the similarity in structural component in the two words chosen, and often indicate the contrast to the third word, which has essentially the same realization content, but a different structural component. For example, in the DATIVE triad, stable--saddle--mane, reasons included "both objects horse uses" indicating the similarity itself and "both are related to the horse but not part of it" indicating the contrast to the dissimilar word mane. In another triad, reasons for choosing to teethe and to coo included

"early action of a child/infant/baby," "both are something babies do; a baby doesn't diaper himself." In giving reasons for the choice of to slice and to stab as most similar, about half of the subjects referred to the instrument itself, e.g., "involve a knife and a cutting action"; the other half referred to the manner of the action only, e.g., "both cutting actions." In the triad, sailboat--windmill--blower, almost all the subjects gave reasons for the predicted choice such as "both are powered by the wind."

Conclusions. When subjects were given three words, all from different fields, two of which shared the same realization of a structural component and the third shared the meaning content of the other two realizations, but not the same structural component, they chose as most similar the two words that did share a structural component. In these triads, unlike the previously reported one-way triads, the reasons given for the choices usually clearly indicated awareness of the structural component under consideration. Thus, these results confirm the use of the six structural components as a basis of similarity judgments under the specific restrictions imposed by the selection of the stimuli in this experiment.

Discussion

The results indicate that only in some special circumstances do the structural components here described as SUBJECT, OBJECT, DATIVE, LOCATIVE, PURPOSE, and INSTRUMENTAL/MANNER provide a basis for subjects' sorting behavior and similarity judgments as a consequence of their representation in the internal lexicon. Thus, previous findings, also confirmed here, that the meaning content of the internal lexicon does provide a basis for similarity judgments was not paralleled by the findings about meaning structure. As predicted, meaning content was consistently more salient to the subjects than meaning structure.

However, sorting does occur by structural component in the presence of some common meaning content, i.e., subjects do perceive similarities based on structural component when there is some kind of common content in a set of items. This tendency is strongly evident in the sorts: here it is possible to subdivide the words sharing a common structural component according to field and indeed subjects do so. This solution-type is the second most frequently given one in the sorts, although it is significantly less salient than the solution based on field alone. Similarly, in the one-way triads, where all words share a common core meaning, the subjects do consistently make the choice predicted on the basis of shared structural component, although difficulties arise in interpreting this result unequivocally as support for the existence of the structural component in their internal lexicons. In the control triads, where the core meanings of all three words differ, but all three words share the content of the realization, choices are based predominantly on shared structural component. Thus, shared structural component is recognized as a basis of meaning judgments, but apparently not when it is the only aspect of shared meaning: some aspect of meaning content must also be shared. Note that such meaning content is shared across all words under consideration, allowing the structural component to function as a distinguishing component. In summary, hypotheses 2, 3, and 4 are supported but hypothesis 1 is not. Other factors may be hindering a direct test of hypothesis 1.

When the subjects' reasons for their judgments are considered, it becomes apparent that the judgments are most immediately determined by strategies. That is, the search for similarities and differences is governed by strategies which have as input both the given set of words and the internal lexicon defining the words. As noted in the Introduction, these strategies must be taken into consideration in making inferences from the judg-

ments to the properties of the internal lexicon. For example, in the one-way triads, the subjects often use a strategy of attempting to interpret one of the three words as a general term subsuming the other two. The result is that they make the predicted judgment, but not for the predicted reasons. When the third term is a general term, this strategy is reasonable. However, in the triads where the third term is not a general term, this strategy leads to a misinterpretation of one of the words, i.e., one of the words is interpreted as a general term for the field, but even with this strategy operating, it is usually the case that if one of the words is chosen as the general term for the field when in fact it is not a word expressing merely the core meaning, it is that word which is not one of the two words sharing the structural component. Thus, presumably, both the prevalent strategy and information from the internal lexicon are involved. Another example of strategies determining judgment occurs in the two-way triads. The two words judged as most different were sometimes not those predicted by the theory. The reasons given seem to suggest that the structural component may nevertheless be present in the subjects' internal lexicon. The strategy of searching for a difference in content makes the structural component mediate a difference rather than a similarity judgment. Thus, in at least these cases, the way in which the internal lexicon is reflected in the judgments made depends on the strategies used by the subjects.

A possible explanation for the overall results is that a scan for similarities and differences in content (rather than structure) is a nearly universal strategy among subjects. This strategy causes the similarities and differences of content to be the most readily perceived, i.e., to be most salient. It would also explain the fact that judgments based on structural

component occur primarily among words that share some obvious meaning content. In these cases, the strategy fails and the subject then looks for some other basis of judgment and uses the structural component. This explanation assumes that structural components are present in the internal lexicon, but are not readily accessible in the measures used due to processing strategy.

If the structural components constitute part of the meaning of lexical items, why do judgments based on them occur less readily than judgments based on content? Differing strategies may indeed be involved, but why do the strategies differ? Perhaps the meaning of 'meaning' in everyday use relates only to content, and, even if structural components are an inherent part of lexical items, they are not subjectively considered to be part of the 'meaning' of the item. Here the use and knowledge about words may differ and may not be reflected in judgments made about them. That such is the case has not been demonstrated, but a primarily content-oriented interpretation of 'meaning' is consistent with the findings.

The question raised in the Introduction regarding the choice of stimulus words can now be clearly resolved. Since the obtained results are not in accord with a bias in the selection of stimuli that would favor similarity judgments being based on structural component, and since such bias was carefully being avoided by the experimenter at a conscious level, and furthermore, since the results do not readily lend themselves to interpretation in terms of any one direction of sampling bias, it is unlikely that any such bias is responsible for the results. However, the problem of sampling and replicability in this type of research remains for future studies (Clark, 1973).

Conclusions

The major conclusions to be derived from this study are primarily methodological. Some of the results indicate that making inferences about the internal lexicon from similarity judgments is much less straightforward a process than previous investigators have assumed. The evidence for this conclusion comes from the processing strategies that were found to be used by subjects in making similarity judgments. The strategies found were not themselves here under investigation, but were discovered post hoc. The extent of their dependence on the particular tasks and stimuli used has not been determined, but their existence argues for the existence of other specific strategies under other conditions. Thus, one cannot assume a direct relationship between similarity judgments and the content of the internal lexicon. Processing must be considered in drawing conclusions about the internal lexicon.

A further methodological consideration that stems from the findings of this study is that the processing strategies involved in similarity judgments may be so strongly content-based that this type of task may be inappropriate for examining the structural relations within words. Other methods may have to be devised to adequately test aspects of meaning such as the structural components proposed here.

Due to the methodological considerations just discussed, any conclusions derived from the present study about the existence of structural components in the internal lexicon must be guarded. As noted earlier, one of the major findings is that subjects tend not to sort words or judge meaning on the basis of structural component. However, some judgments based on structural component do occur, albeit under special conditions. In contrast, a purely associationistic conception of the internal lexicon

would not explain the similarity judgments that coincided with the predictions made on the basis of the kind of quasi-sequential semantic structures propsed. The evidence, then, gives some limited support for the model but in doing so, the methodology and its underlying assumptions are questioned.

Footnote

1. The author is grateful to Martin D. S. Braine both for his continued guidance and encouragement during the preparation of the Ph.D. dissertation (University of California, Santa Barbara, 1972) that this report is based on and for the many suggestions that have been incorporated in this report. A number of additional related experiments are reported only in the unpublished dissertation. Preliminary findings were presented at the meeting of the Western Psychological Association, Portland, Oregon, April 26-29, 1972 and the post hoc analysis of processing strategies was presented at the meeting of the Southeastern Psychological Association, New Orleans, Louisiana, April 6-8, 1973.

Requests for reprints should be addressed to the author at the Educational Psychology Department, University of Georgia, Athens, Georgia 30602.

References

Clark, H. H. (1973). The language-as-fixed-effect fallacy: a critique of language statistics in psychological research. J. verb. Learn. verb. Behav., 12, 335.

Collins, A. M. and Quillian, M. R. (1970). Experiments on semantic memory and language comprehension. In L. W. Gregg (ed.), Cognition in Learning and Memory (New York).

Fillenbaum, S. and Rapoport, A. (1971). Structures in the subjective lexicon (New York).

Fillmore, C. H. (1968). The case for case. In E. Bach and R. T. Harms (eds.), Universals in linguistic theory (New York).

Gruber, J. (1967). Functions of the lexicon in formal descriptive grammar. Technical Memorandum, TM-3770/000/00 System Development Corporation (Santa Monica, California).

Henley, N. M. (1969). A psychological study of the semantics of animal terms. J. verb. Learn. verb. Behav., 8, 176.

Kintsch, W. (1972). Notes on the structure of semantic memory. In E. Tulving and W. Donaldson (eds.), Organization in memory (New York).

Meyer, D. E. (1970). On the representation and retrieval of stored semantic information. Cognitive Psychol., 1, 242.

Miller, G. A. (1969). A psychological method to investigate verbal concepts. J. math. Psychol., 6, 169.

Newmeyer, F. J. (1970). On the alleged boundary between syntax and semantics. Foundations of Language, 6, 178.

Postal, P. M. (1970). On the surface verb "remind." Linguistic Inquiry, 1, 37.

Quillian, M. R. (1967). Word concepts: a theory and simulation of some

basic semantic capabilities. Behavior Science, 12, 410.

Rumelhart, D. E., Norman, D. A. and Lindsay, P. H. (1972). On a semantic structure for long-term memory. In E. Tulving and W. Donaldson (eds.), Organization in memory (New York).

Steinberg, D. D. (1967). The word sort: an instrument for semantic analysis. Psychonom. Science, 12, 541.

Winograd, T. (1972). Understanding natural language. Cognitive Psychol. 3.

Table 1

The Basic Components Proposed as the Underlying Structure of Word Meaning in a Number of Lexical Items

Core Meaning	Realization of the Structural Component	Lexical Item
Structural Component: SUBJECT		
'to vocalize'	'horse'	to neigh
" " "	'dog'	to bark
" " "	'cat'	to meow
'to decay'	'living'	to rot
" "	'food'	to spoil
Structural Component: OBJECT		
'to wash'	'hair' or 'rug	to shampoo
" "	'clothes'	to launder
'to burn'	'corpse'	to cremate
'to kill'	'collective, animate'	to massacre
" "	'political or religious personnage'	to assassinate
" "	'animate, non-human'	to butcher
Structural Component: DATIVE		
'building'	'for dogs'	kennel
" "	'for chickens'	coop
'clothing'	'for infant'	diaper
Structural Component: PURPOSE		
'covering'	'protection against rain'	umbrella
" "	'protection against sun'	parasol
" "	'protection against attack'	shield
'container'	'for frying food in'	skillet
" "	'for religious use'	chalice
Structural Component: LOCATIVE		
'inhabitant'	'village'	villager
" "	'room'	roomer
'air'	'above a planet'	atmosphere
Structural Component: INSTRUMENTAL/MANNER		
'to hit'	'with a whip'	to flog
" "	'with a fist'	to punch
'to garden'	'with a hoe'	to hoe
" "	'with a rake'	to rake
'to move'	'slowly and heavily'	to plod

Table 2

Number of Ss making the Most Similar and Most Different Choices in the Two-Way Triads

Triad[a]	Most Similar			Most Different		
	F[b]	S	O[c]	O[d]	S	F
SUBJECT Structural Component						
to walk, to waddle, to sire	13**	2	0	9*	5	0
to call, to bark, to suckle	16***	0	2	8	16	0
to cough, to meow, to trot	19***	1	0	10	6	4
OBJECT Structural Component						
glutton, carnivore, suicide	18***	0	0	9	9	0
strangulation, infanticide, herbivore	18***	0	0	10*	7	1
DATIVE Structural Component						
shoe, diaper, nest,	15*	5	0	19***	1	0
hotel, hive, reins	18***	0	0	12**	5	1
umbrella, eyelid, coffin	15***	2	3	9	9	2
container, udder, leash	19***	0	1	8	7	2
PURPOSE Structural Component						
appliance, dryer, tugboat	20***	0	0	5	15	0
mountaineer, explorer, parasol	18***	0	1	13**	6	0
vest, apron, warship	19***	1	0	8	12	0
vehicle, tractor, refrigerator	18***	1	1	11*	9	0
building, church, aphrodisiac	14***	1	1	7	9	0
LOCATIVE Structural Component						
bathroom, attic, cockpit	14*	4	2	15***	5	0
inhabitant, ferman, oceanliner	17***	1	1	11*	7	1
hurricane, atmosphere, villager	19***	0	1	9	11	0
vehicle, dunebuggy, mountaineer	20***	0	0	11*	8	1
tenant, suburbanite, beachcomber	16**	4	0	9	8	2
SOURCE Structural Component						
meat, pork, cotton	20***	0	0	13**	7	0
fabric, wool, beef	20***	0	0	11*	8	1
INSTRUMENTAL/MANNER Structural Component						
to dig, to shovel, to knead	18***	0	1	8	11	0
traveller, pedestrian, steamboat	19***	0	1	1**	19	0
to assassinate, to electrocute, to hoe	20***	0	0	12*	8	0
gunboat, rowboat, windmill	20***	0	0	14***	6	0
to hit, to punch, to mop	19***	1	0	10	10	0

[a] The first two items in each triad are from the same field (F) and the second two have different realizations of the same structual component.

[b] Asterisks indicate a significant difference between F and S choices in a sign test.

[c] O indicates unpredicted pair; omissions may be calculated by subtracting the total choices (F, S, & O) from 20.

[d] Asterisks indicate the significance level of x^2 comparing the predicted choice (O) and the other two choices combined.

*p < .05
**p < .01
***p < .001

Table 3

Number of Ss making each Most Similar Choice in the first One-Way Triads

Experiment

Triad[a]	Most Similar Choice[b]		
	1-2[c]	2-3[c]	1-3[c]
SUBJECT Structural Component			
to bark, to meow, to cry	25***	5	0
to calve, to foal, to reproduce G	25***	0	0
to neigh, to quack, to call	26***	2	1
OBJECT Structural Component			
carnivore, herbivore, dieter	28***	1	0
infanticide, genocide, murder G	22***	1	2
to shampoo, to launder, to rinse	11	3	16
DATIVE Structural Component			
kennel, stable, restaurant	30***	0	0
pod, cocoon, container G	26***	2	2
sty, coop, shed	18***	5	3
PURPOSE Structural Component			
refrigerator, toaster, appliance G	26***	4	0
battleship, tugboat, vessel G	21***	2	5
umbrella, shield, robe	16*	0	14
plow, sickle, implement G	27***	1	0
hospital, restaurant, building G	28***	1	1
LOCATIVE Structural Component			
Californian, Texan, resident G	29***	0	0
plane, boat, craft G	25***	5	0
attic, cellar, den	27***	2	0
oceanliner, riverboat, vessel G	18**	0	11
mountaineer, beachcomber, traveller G	25***	1	3
INSTRUMENTAL/MANNER Structural Component			
to stab, to shoot, to wound G	26***	0	4
cyclist, motorist, tourist	30***	0	0
sailboat, rowboat, gunboat	28***	1	0
to guillotine, to electrocute, to execute G	27***	2	1
To sweep, to mop, to clean G	28***	2	0

[a] All words in each triad are from the same field. The first two items in each triad share the structural component indicated, whereas the third item is a general (G) word or has a different structural component.

[b] The number of omissions may be calculated by subtracting the total choices listed for each triad from 30.

[c] 1-2, 2-3, and 1-3 refer to the combinations of the 1st, 2nd and 3rd words in each triad.

*$p < .05$ for the x^2 comparing the predicted choice (1-2) with the combined other two choices. **$p < .01$ as above; *** $p < .001$ as above.

Table 4

Number of Ss making each Most Similar Choice in the Second One-Way Triads

Experiment

Triad[a]	Most Similar Choice[b]		
	1-2[c]	2-3[c]	1-3[c]
SUBJECT Structural Component			
to neigh, to trot, to mount	13	12	0
to teethe, to coo, to diaper	19***	2	3
OBJECT Structural Component			
to mount, to harness, to whinny	23***	1	0
to diaper, to cradle, to babble	21***	1	0
DATIVE Structural Component			
stable, saddle, mane	20***	5	0
pacifier, crib, papoose	8	17	0
LOCATIVE Structural Component			
to float, to sail, to rinse	24***	0	1
boat, buoy, faucet	25***	0	0
PURPOSE Structural Component			
umbrella, raincoat, puddle	25***	0	0
pill, forceps, scar	17***	6	1
INSTRUMENTAL/MANNER Structural Component			
to stab, to slice, to sheathe	17***	6	0
sailboat, windmill, blower	20***	3	0

[a] The first two words in each triad share the same realization of the structural component indicated, but are from different fields; the third word is from yet another field but share the meaning content of the realization with the other two words.

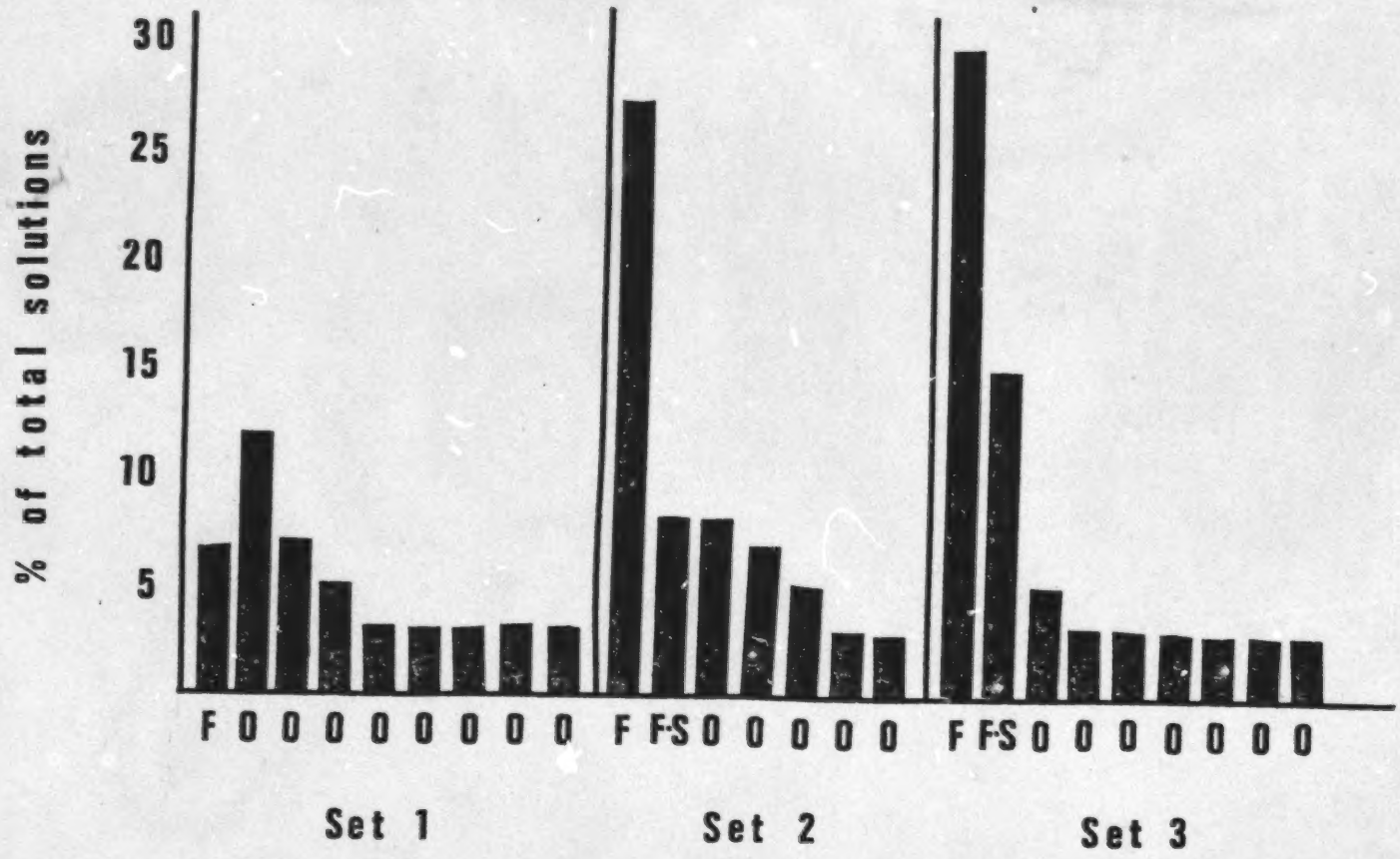
[b] The number of omissions may be calculated by subtracting the total choices listed for each triad from 25.

[c] 1-2, 2-3, and 1-3 refer to the choice of the combinations of the 1st, 2nd, and 3rd words in each triad.

***$p < .001$ for the x^2 comparing the predicted choice (1-2) with the combined other two choices.

Figure Caption

Figure 1. Common solutions based on field (F), on field and structural component (F-S) and other (O) common solutions as a percentage of all solutions given in the sorts.


% of total solutions
30
25
20
15
10
5
F O O O O O O O O O F F-S O O O O O F F-S O O O O O O O
Set 1
Set 2
Set 3